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BY

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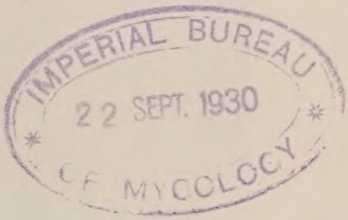

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MACHINES FOR COATING SEED WHEAT WITH COPPER CARBONATE DUST

By A. H. HOFFMAN and H. L. BELTON

Several years' use of copper carbonate dust on seed wheat has proved conclusively that when properly applied it is an almost absolute preventive of bunt or stinking smut and yet that it does not in the least injure the seed. Many means have been devised for applying this fungicide, only some of which have fully met the requirements.

Requirements.—A machine for this purpose should:

1. Coat each kernel completely. Viewing with a good magnifying glass a representative sample of the treated grain will determine how well this has been done. (See fig. 1.)

Fig. 1.—A magnifying glass should show that every portion of the surface is covered. Group (1) satisfactory, (2) untreated, (3) unsatisfactory.

2. Allow little or none of the copper carbonate to escape into the air, since this chemical is not only irritating to the eyes and the mucous linings of the nasal passages, but is poisonous.

3. Have sufficient capacity for the amount of grain to be treated in the time available.

4. Clean itself completely to prevent mixing different varieties of seed. This is important particularly in custom and experimental work.

Furthermore, it should be low in cost, simple in construction, durable, economical of power, and easy to operate, and its repair parts should be obtainable within a reasonable distance. In machines designed to treat a continuous stream of grain, the proportioning of dust to grain should be secured by a device that is adjustable, yet positive in its action.

Unsatisfactory Machines.—A study of most of the types of machines used in this state shows that many of them are unsatisfactory. Their most common fault is their inability to prevent the escape of the dust into the air. In fact, some escapes from practically every machine in use. The amount depends principally upon the tightness of the walls and the connections of the mixing chamber, on the design and construction of the emptying and sacking arrangements, and on the correct proportioning of dust to grain. When appreciable amounts of dust escape from a machine used indoors, goggles and dust masks should be used. Both of these devices have long been employed in connection with various manufactures and are readily obtainable.[1] A mask may be made from one or two layers of thin felt or heavy cotton flannel, lint side outward, or may consist merely of a damp sponge. However, at best, a mask is an uncomfortable thing, especially when the wearer is working. There is, therefore, always a temptation to leave it off and risk the consequences. Moreover, some kinds of masks are ineffective, affording at times little or no protection. Hence it is much better to prevent the escape of the dust, to gather it up with some sort of a vacuum fan, or to place the dusting machine in a drafty hallway or out of doors and use it only when there is a good breeze in the right direction to blow away the escaping dust.

Some of the machines tried did not coat the seed thoroughly, one in particular, a screw conveyer into which the grain and dust were fed. Instead of mixing, the dust settled to the bottom of the stationary conveyor tube, permitting much grain to be discharged uncoated.

[1] Mackie, W. W., and F. N. Briggs. Fungicidal dusts for the control of bunt. California Agr. Exp. Sta. Bul. 364:563–564. 1923.

Batch Mixers.—Mixers of this type are given a measured charge of grain and a proportionate charge of the dust. The machine is closed and operated for the requisite time, then opened and the grain permitted to run out. It is theoretically possible by this process to secure a perfect coating of dust on every kernel with no residue provided the proportioning is correct and the time of operation sufficient. Every batch mixer studied applied the dust satisfactorily when turned long enough.

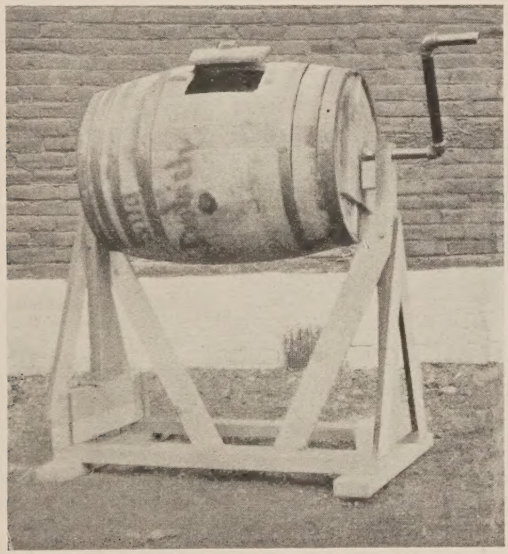

Fig. 2.—Barrel-type dusting machine, designed by H. E. Drobish and H. E. Paxton. With this machine one man and a boy dusted satisfactorily 8500 lbs. of wheat in one ten-hour day. Much dust escapes when resacking. Best speed about 45 r.p.m.

In a batch mixer two ounces of dust are used for each bushel (60 lbs.) of wheat. One may be tempted to increase the ratio of dust to grain in order to secure thorough coating in less time. However, if this is done, three difficulties are liable to arise: (1) excessive dust puffing out through the sides of the sack while the treated grain is filling it; (2) clogging of the grain drill by the excess of dust; (3) too much dust in the air when an end-gate seeder is used. Passing the grain over a suitable screen will remove the excess. Another tendency is to put in too large a batch of grain. The best amount is a volume of about one-fourth to one-third the space inside the box, according to the design. Too large a charge makes the mixing less thorough and somewhat slower.

A rotary barrel-type churn (fig. 2) is satisfactory if filled about one-fourth full and if turned slowly. The grain must *fall* from end to end (or from side to side) of the churn.

A revolving concrete mixer may be made to do good work, but is liable to permit too much dust to escape, even though the openings be covered with canvas or improvised lids.

A tight box mounted on a shaft and revolved slowly by hand or by a suitable motor or engine is satisfactory. (See fig. 3.) The revolving box of figures 4 and 5 having its shaft placed diagonally, requires more space up and down and a slightly stronger supporting frame, but will mix much more rapidly and is easier to empty from

Fig. 3.—Revolving box mixer, A. D. Buffum, Stratford, California. About 250 lbs. wheat and eight ounces dust are revolved two minutes at 30 r.p.m. in box "A" 6 ft. x 4 ft. x 4 ft. Grain runs out by hinged door "B" into hopper "D." Sacked through chutes "C." Wagon "E" is backed to mixer. Mixing thorough. Much dust escapes on emptying. Two h.p. engine is used.

the corner opening. A box mixer tightly and rigidly built and painted in the joints with a good lead-oil paint, and having its door well fitted and firmly closed, permits little dust to sift out during operation.

The mixer shown in figures 4 and 5 is too large for the greatest economy either in construction or in use. A cubical shape is preferable to the oblong. A box thirty inches each way inside is much cheaper to build and to mount and is easier to keep from racking. It requires about one-half as much power. Also, since the sides are steeper, the treated grain runs out more readily at the low corner. If the filling is done by hand from sacks, the smaller machine is easier to load.

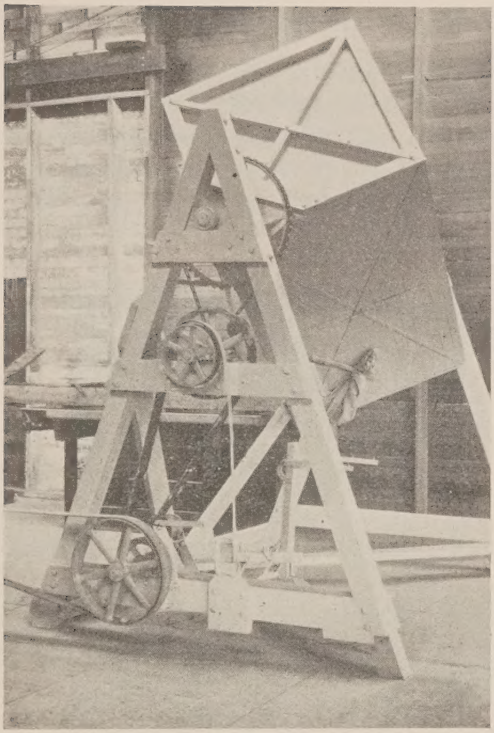

Fig. 4.—Diagonal shaft makes mixer more effective. Tight construction and direct sacking from mixer reduces amount of dust escaping. Size shown, 3 x 3 x 5 ft. inside. Capacity 350 to 600 lbs., speed 33 r.p.m., requires 6 h p. Thirty inches each way would be a more satisfactory size and require only half as much power.

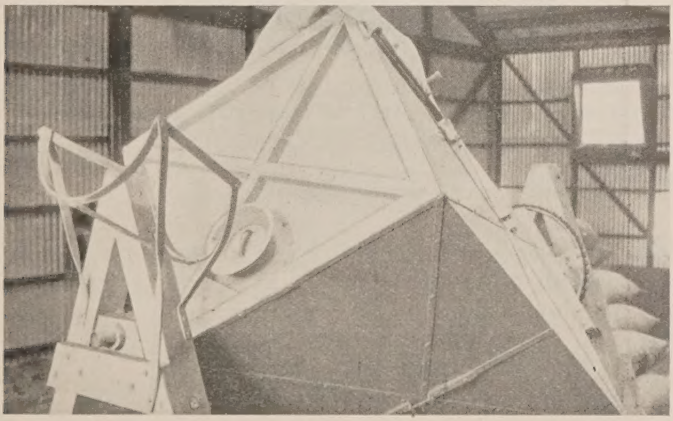

Fig. 5.—Grain inlet of diagonal mixer. The neck and lid of a discarded milk can were found satisfactory. A removable sheet metal chute is supported on the iron framework.

If a box mixer is to be used for several seasons it should be housed in a dry place and painted at least once in three years.

To prevent racking and the development of leaky joints, for the size shown in figure 4 the box should be made of at least ⅞-inch tongue-and-grooved flooring of the best quality. The nailing and bracing should be well done, and only well-seasoned lumber used.

Fig. 5A.—Treated grain outlet for diagonal box mixer. Canvas tube "K" surrounds the outlet. Wooden spring "L" holds "K" while machine turns. "M" is a close-fitting slide. Sack hangs from sackholder "N" and is surrounded by sheet metal housing "H." A vacuum fan draws away through the opening "O" any dust that boils out through sides of sack. Fan and sack housing not needed if machine is used in a good draft.

Continuous Mixers, Revolving Type.—For warehouse and ranch use where large quantities of grain are to be treated, the batch mixers are, in general, of too small capacity and require too much labor to be satisfactory. There are several devices in use which receive at one end a stream of grain and dust in the right proportion, and discharge at the other the treated grain. These are of two kinds: the revolving type and the gravity type.

Figure 6 shows a small mixer of inclined revolving cylinder type which has been on the market for several years. It allows some dust to escape and, for this reason, is generally used out of doors. A later model has a vacuum fan with an air inlet close to the mouth of the pipe which discharges the treated grain. This draws some of the excess dust out of the sack.

It was found that some users of machines of this kind had increased the slope by raising the hopper end so as to hasten the flow of the grain through the machine. This is liable to result in imperfect coating.

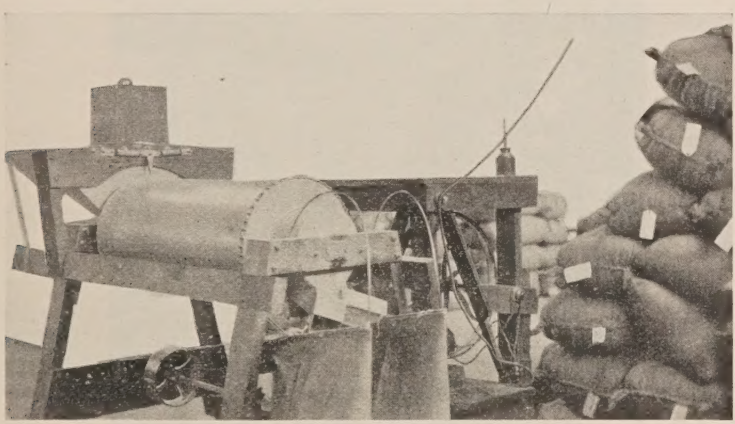

Fig. 6.—A revolving type, continuous mixer. Driven by 1 h.p. motor, it mixes satisfactorily about 1800 to 2500 lbs. wheat an hour. Allows some dust to escape.

Figure 7 shows a home-made continuous mixer of the revolving cylinder type made out of an old hot water tank and some used pulleys and shafting. Unless care and skill are used in designing and constructing such a machine, too much dust will escape into the air. It is possible to put a tight housing around such a mixing cylinder, but its construction would require considerable labor and skill.

Figures 8 and 9 show a large mixer of the continuous type which is constructed somewhat like that of figures 6 and 7. Unless a vacuum fan is used, much dust escapes into the air.

In figure 9 a general idea is given of the inside construction of the machine of figure 8. As will be observed, there are two sets of baffles inside the revolving cylinder, one set consisting of long narrow iron strips placed parallel to the shaft, the other of short plates placed at an angle with the shaft. The long baffles throw the grain over

and over and tend to move it down towards the outlet. The short baffles tend to throw the grain back up the incline away from the outlet, thus slowing the progress of the grain through the cylinder and causing more thorough coating.

The vacuum fan should have its intake connected by one tube to the sack housing (not shown) and by another to the top of the grain

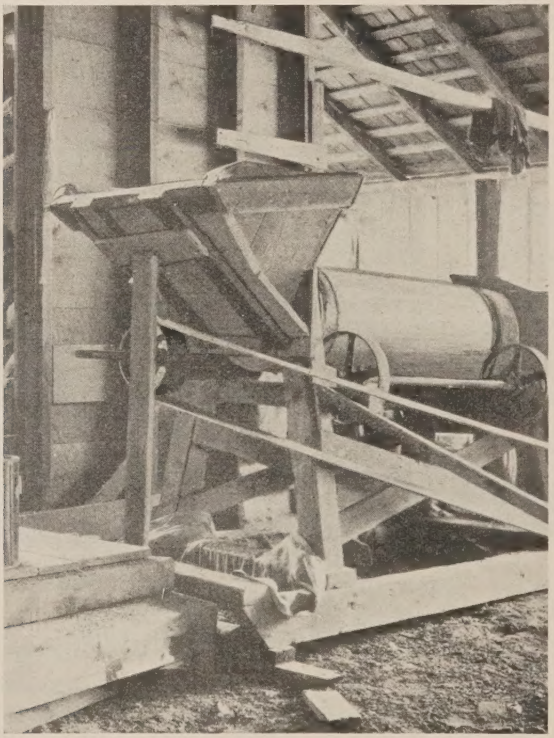

Fig. 7.—Home-made continuous mixer built by Mr. Baker, Richvale, California. Treats 2500 lbs. wheat an hour. Much dust escapes.

receiving bin. Each tube should have a regulating valve or damper. Drawing air from the grain bin causes air to enter through all the chinks and open joints of the machine and thus prevents the escape of dust.

Generally speaking, in revolving-type mixers the design of the interior of the revolving members may differ quite widely with a correspondingly wide difference in effectiveness. The mixer of figures 4 and 5 requires no baffles, since the oblique placing of the shaft

Fig. 8.—Continuous, revolving cylinder type, used at the W. D. Lewis grain warehouse, Guernsey, California. Grain from chute runs into hopper "A," where dust from proportioning device "B" is added. Grain and dust run into upper end of revolving steel cylinder "C." Treated grain falls into bin "E," thence into sacks. Hand wheel "D" adjusts flow of grain. Much dust escapes unless a vacuum fan is used. Mixing satisfactory. Capacity about 7500 lbs. wheat an hour.

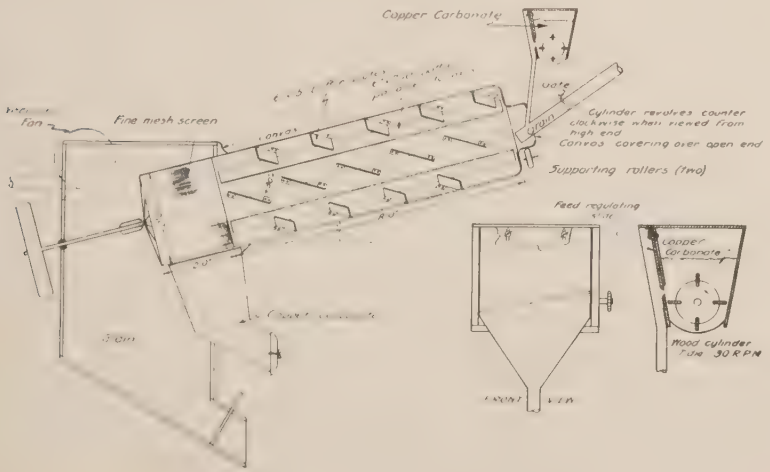

Fig. 9.—Section sketch of the mixer of figure 8.

causes the grain to be thrown to both right and left parallel to the shaft, and, at the same time, to be rolled over and over. The machines of figures 2 and 3 should have baffles similar to those in a revolving concrete mixer. They should be so placed as not to hinder too much the outflow of the treated grain. The height of any baffle should not exceed one-sixth of the diameter of the cylinder (or of the width of a side).

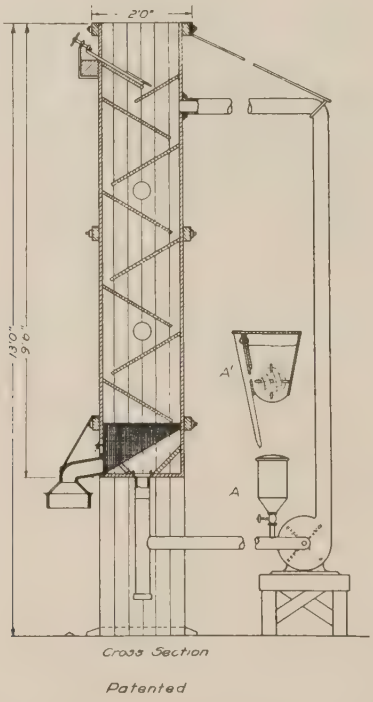

Fig. 10.—A gravity-type mixer (section view). Grain thrown from side to side by baffles, falls through cloud of dust circulated by blower. Excess dust drawn out through screen and re-circulated. The pipes broken away indicate that the mixer may be placed out of doors and the motor inside. "A" and "A'" are alternative dust proportioners.

The speed of rotation must be carefully chosen to fit the size. If the speed is too high, it will cause the centrifugal effect to overcome the gravity effect on the grain and prevent satisfactory operation, while if too slow, it will reduce the capacity of the machine. The speed that requires the most power and produces the most violent tumbling about of the grain is the best. This applies to all machines

having a revolving mixing chamber. The larger the diameter of the revolving part the slower must be the speed. See figures 2, 3 and 4.

Continuous Mixers. Gravity-Type.—Figures 10 and 11 show a patented gravity-type mixer. This machine has a vertical chute through which the grain falls. Sloping baffle plates attached to two opposite walls cause the grain to be thrown from side to side as it falls. The copper carbonate is applied as a dust cloud surrounding

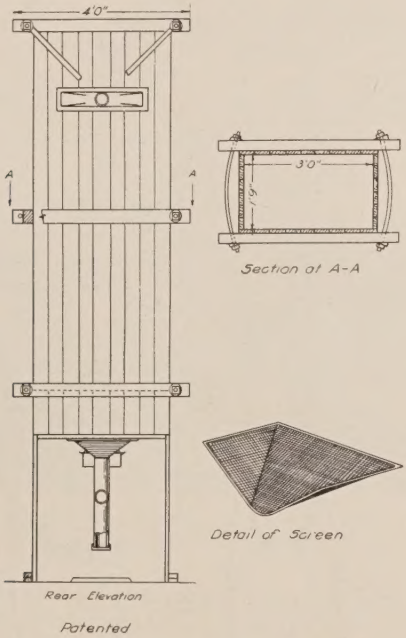

Fig. 11.—The gravity-type mixer of figure 10, side and section views. Tight construction is essential. With proper construction mixing is satisfactory and little dust escapes into the air. Capacity about 9000 lbs. an hour for the size shown.

the falling grain. Air and dust are circulated downward through the mixer chute by the use of a blower. This machine requires less chemical than most others because it draws out the excess dust through a screen at the bottom and recirculates it.

The capacity depends on the width, breadth and height of the vertical chute. One of these machines measuring over all 13 feet high, and 2 feet by 4 feet (inside, 9 ft. 6 in. high and 1 ft. 9 in. x 3 ft.) treats 9000 lbs. an hour.

The slope of the inclined baffles should be steep enough to cause the grain to fall readily and the machine to clean itself completely. Dusted grain will lodge on a much steeper slope than untreated grain.

When the proportioning device A (fig. 10) was used, the feed of dust was found to be irregular, and the coating of the grain non-uniform. Also considerable dust escaped whenever the dust feed was

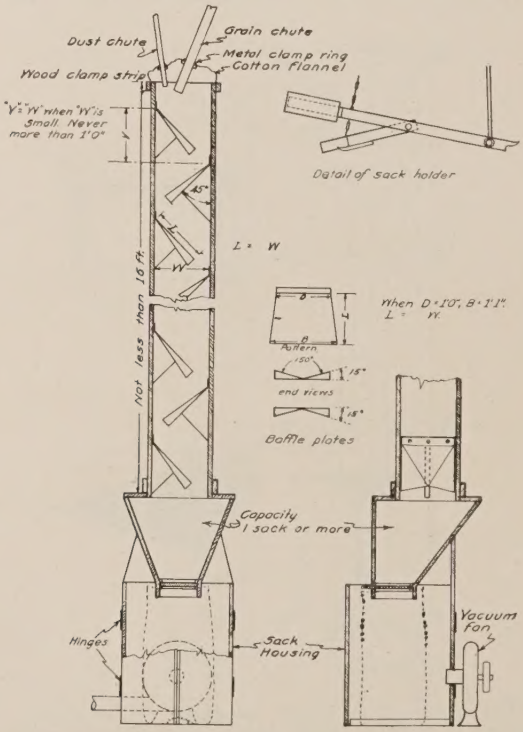

Fig. 12.—A mixer of the plain gravity-type. Sack housing and vacuum fan are unnecessary if machine is used in a good draft.

momentarily too rapid. If a positive action dust feeder such as A′ is used with this machine, the coating should be satisfactory, with little excess of dust left with the treated grain or escaping into the air.

A mixer of the plain gravity-type without means for circulating dusty air around the falling grain was found in use on a ranch in this state. Its approximate construction is shown in figure 12. An ordinary bucket-type elevator raised the grain from a dump pit to the top

of the mixer. A dust proportioning device somewhat similar to A′ of figure 10 was located at the top of the mixing chute and its shaft driven from the top shaft of the elevator. The baffles were flat instead of the alternating V- and inverted V-shape shown in the figure. Considerable dust escaped because of loose joints and inadequate provision for taking care of the out-rush of air while the receiving bin at the bottom was filling with grain during the changing of sacks.

The cloth construction indicated as surrounding the dust and grain tubes as they enter the top of the mixing chute acts as a breather

Fig. 13.—Combination of re-cleaning and dusting saves time and labor. One gas engine drives both these machines.

equalizing the air pressure but preventing the escape of dust. Thin felt or heavy eiderdown blanketing is better than cotton flannel. A ribbon of cotton flannel or felt should be placed in such joints as might leak. Knot holes may be closed by the use of cotton waste or rags moistened with shellac varnish and tamped in securely.

Recleaning and Dusting.—Figure 13 indicates how time, labor, and power may be economized by recleaning and dusting in the same operation. The outfit shown was belted to a stationary gas engine of about 3 h.p.

Collecting Escaped Dust.—Usually much dust boils out through the sides of the sack while the treated grain is running out of a mixer of any type. A vacuum cleaner or suction fan drawing its air from a sheet metal or wooden housing surrounding the sack will take care of this dust. The air discharged from the fan may be piped outside

or may be cleansed by passing through the ordinary vacuum cleaner bag or through one made of a suitable felt. The dust caught may be used again. Except in large commercial dusting operations the small amount of dust caught will not be worth the trouble to recover it. However, if left to float about the room, a small fraction of an ounce might cause much distress to a person breathing it.

Treated Grain Dangerous.—After working with copper carbonate or treated grain, the hands should be thoroughly washed before touching food. The treated grain is poisonous to livestock of all kinds as well as to rodents. Weevils also are unable to live in it.

Manufacturers of Dusting Machines.—The Agricultural Engineering Division, College of Agriculture, University of California, Davis, California, will furnish manufacturers' addresses on request.

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